

UNIVERSITY OF SASKATCHEWAN

College of Engineering

G.E. 120.3

Introduction to Engineering II

FINAL EXAMINATION #2

April 28, 2003

2:00 AM - 4:00 PM

STUDENT NAME: _____

STUDENT NUMBER: _____

LECTURE SECTION: • L02 Tu-Th 11:30 – 1:00 Prof. H.C. Wood
• L04 Tu-Th 1:00 – 2:30 Prof. T.G. Crowe
• L06 Tu-Th 2:30 – 4:00 Prof. T.C. Muench

Question 1	/ 8
Question 2	/ 10
Question 3	/ 10
Question 4	/ 12
Question 5	/ 20
Question 6	/ 15
Question 7	/ 20
TOTAL	/ 95

GENERAL INSTRUCTIONS FOR THE QUESTIONS

- 1) **NO** textbooks, **NO** notes, **NO** assignments, and **NO** laboratory logbooks/reports.
- 2) **NO calculators allowed.**
- 3) Neatness counts. Please ensure your paper is readable.
- 4) Some questions contain special instructions. Please ensure that you read these carefully.
- 5) Not all questions are of the same difficulty and value. Consider this when allocating time for the solution.
- 6) *IF A QUESTION PROVES TO BE TOO HARD FOR YOU TO SOLVE, GO ON TO ANOTHER QUESTION! RETURN TO THE TROUBLESOME QUESTION WHEN TIME PERMITS.*

PLEASE NOTE

ALL parts of the examination paper MUST be handed in before leaving.

Please check that your examination paper contains 8 pages TOTAL.

QUESTION #1**MARKS: 8 (8)*****Logic Problem - With or Without You***

"U2" have a concert that starts in **17 minutes** and they must all cross a bridge to get there. You must help them (with advice only) cross to the other side. All four men begin on the same side of the bridge. It is at night and there is only one flashlight. A maximum of two people can cross (or be on) the bridge at one time. Any party that crosses, either 1 or 2 people, must have the flashlight with them. The flashlight must be walked back and forth (i.e., it cannot be thrown, etc.).

Each band member walks at a different speed. A pair must walk together at the rate of the slower man's pace:

- Bono: 1 minute to cross bridge
- Edge: 2 minutes to cross bridge
- Adam: 5 minutes to cross bridge
- Larry: 10 minutes to cross bridge

For example, if Bono and Larry walk across first, 10 minutes have elapsed when they get to the other side of the bridge. If Larry then returns with the flashlight, a total of 20 minutes have passed and you have failed your mission.

Notes:

There is no trick behind this (i.e., no running, piggy-backing, swimming, etc.). It is the movement of resources in the appropriate order.

It is solvable. In fact there are **two known answers**

QUESTION #2**MARKS: 10 (6+4)**

The following 3 points are 2D points shown in Homogeneous coordinates.

$$p = [4 \quad 8 \quad 4]$$

$$q = [4/3 \quad 4 \quad 4]$$

$$r = [16/3 \quad 0 \quad 4]$$

- 1) For a 2D line with slope $\frac{3}{4}$ and y-intercept $\frac{1}{4}$, and using homogeneous coordinates, show that one of the following 3 points is on the opposite side of the line from the other 2.
- 2) What is the distance from **point r** to the line?

QUESTION #3**MARKS: 10 (3+2+2+3)**

Given the following 3 equations:

$$3X_1 + 2X_2 - 9X_3 = -65$$

$$-9X_1 - 5X_2 + 2X_3 = 16$$

$$6X_1 + 7X_2 + 3X_3 = 5$$

and using the standard notation $[A][x] = [b]$,

- 1) Show MATLAB instructions (EXACTLY as they would be typed in MATLAB) to solve for $[x]$.
- 2) Show a second method of solving for $[x]$ using MATLAB.
- 3) Given that you can't use an Adjoint function within MATLAB to solve directly, how else might you solve for Adjoint of $[A]$. Show how you would implement it in MATLAB.
- 4) For the complex number, z , of magnitude $\sqrt{2}$, and angle of 45° , show the MATLAB instructions to enter the complex number, and then to calculate z^3 .

QUESTION #4

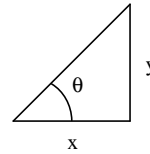
MARKS: 12 (6x2)

- 1) Briefly describe the relationship (differences and similarities) between the second year curriculum at the U of S for Civil Engineering and Geological Engineering.
- 2) In the Geological Engineering lab exercise, what was the primary criterion when selecting the bit sizes for each portion of the well?
- 3) A military “expert” leaves an GPS receiver in a single location and records the latitude and longitude that is displayed over a period of time. In the analysis of the data, the “expert” concludes that the indicated position varied by less than ± 2 m. Further, the “expert” claims that this receiver could be embedded in a “smart bomb”, allowing it to hit a predetermined target with an accuracy of ± 2 m. How would you respond? Constrain your comments to the accuracy of the positional data.
- 4) An ethanol production facility is being planned for construction in southern Saskatchewan. List a total of 2 roles that a Chemical Engineer might fill in the design, construction and/or operation of this facility.
- 5) Briefly explain the reason why the reboiler in the Chemical Engineering lab was taken out of service for maintenance.
- 6) The discipline of Engineering Physics is most like what other discipline represented at the U of S? Briefly explain your answer (why you think so).

QUESTION #5**MARKS: 20 (3+12+5)**

- 1) You calculate the cross product of 2 vectors: $[2, 0, 0]$ and $[-3, 0, 0]$. What is the physical interpretation of this result?
- 2) Using the information in the table listed below (trigonometric information provided to you to calculate angles, since you do not have a calculator), sketch the following and calculate the magnitude and phase angle within the limits that the phase angle is greater than -180° and less than or equal $+180^\circ$.

a. $\frac{6-6j}{j}$



q	X	Y
45	0.25	0.25
27	0.5	0.25
18	0.75	0.25
14	1	0.25
63	0.25	0.5
45	0.5	0.5
34	0.75	0.5
27	1	0.5
72	0.25	0.75
56	0.5	0.75
45	0.75	0.75
37	1	0.75
76	0.25	1
63	0.5	1
53	0.75	1
45	1	1

b. $-3+j$

c. $4-6j$

d. $(4+j)^4$

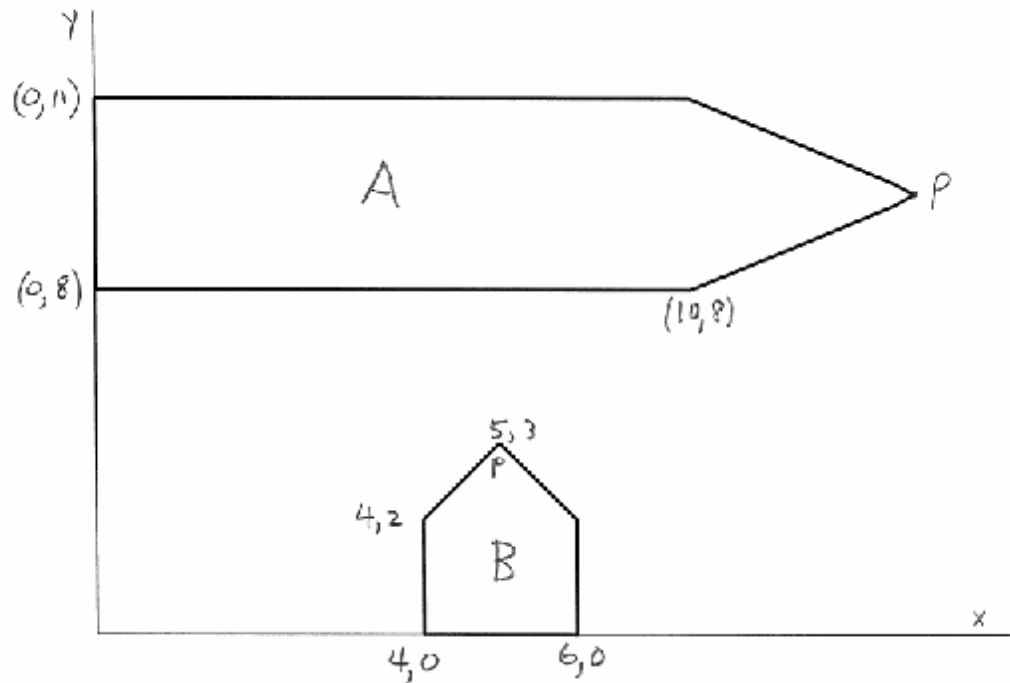
- 3) Find all scalars, k such that the magnitude of kv equals 3, where v is the vector, $v=[1,2,4]$.

QUESTION #6**MARKS: 15 (5+10)**

The following sequence of operations was used to transform the planar object A to B:

SCALING, ROTATION, TRANSLATION.

- What are the coordinates of point P in object A (show your work).
- Describe each operation, with both words and sketches. For each operation, determine the magnitudes (i.e. magnitudes of scales, rotation and translations), and give the mathematical formula for each step.



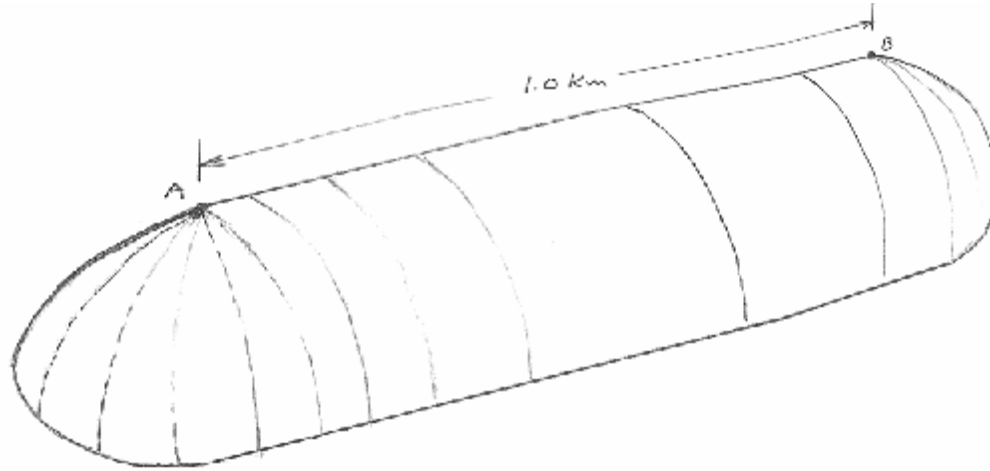
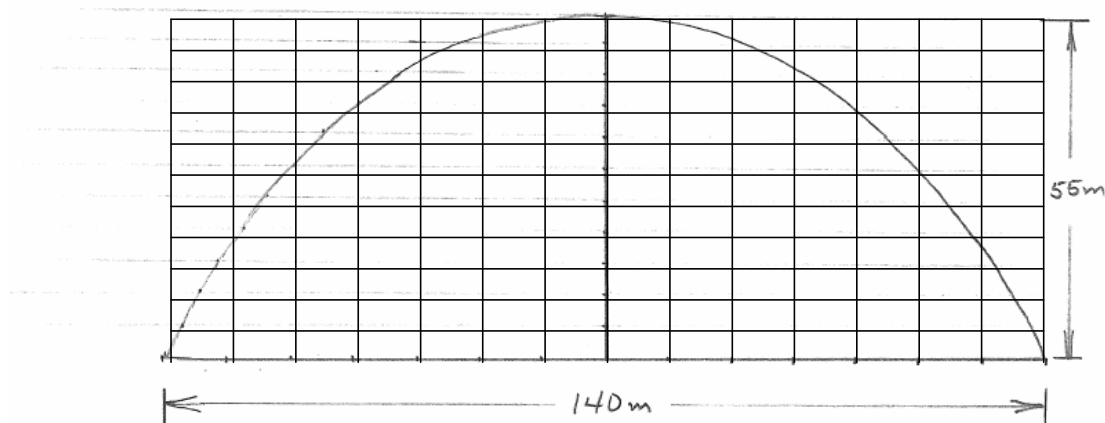
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QUESTION #7**MARKS: 20 (15+5)**

A mining company piles the waste product from its processing operations in large mounds on the surface. One such mound is shown in Figure A. The cross section of the mound along its length is shown in Figure B. The cross section is uniform for the entire length of the mound, except for the ends, where the profile is the same as for one of the sides.

- Estimate numerically the volume of the mound, and estimate the accuracy of your result. Think carefully about the best choice of sections for numerical calculations, especially considering the best way to calculate the end sections.
- If the density of the material is 5 grams per cubic centimeter, what is the total weight of the mound, and what is the average pressure due to the material on the ground?

**FIGURE A****FIGURE B**

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